PRELIMINARY ENGINEERING REPORT

FOR THE

REPLACEMENT OF THE EXISTING 6 INCH FORCE MAIN

SERVING THE MORGAN COUNTY CORRECTIONAL COMPLEX

IN

WARTBURG, TENNESSEE

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I. PURPOSE

The subject project is proposed to increase the wastewater discharge capacity from the Morgan County Correctional Complex (MCCX) to the Wartburg wastewater treatment plant. The proposed increase will allow the MCCX to install a secondary wastewater pumping system; which will provide the prison with an emergency back-up system should the primary wastewater pump system experience a failure, or need to be taken off-line for any reason. The existing six-inch force main from the MCCX facility to the Wartburg Wastewater Treatment Plant is not large enough to carry the peak flows from the MCCX; therefore, when the prison facility was expanded in 2006 an Equalization Tank (the Crom Tank) was constructed to temporarily store the peak flows and release the wastewater at a constant rate. All wastewater flows must currently be routed through the Crom Tank therefore, a redundant system cannot be installed until the pipe to the wastewater plant is increased in size.

II. POPULATION SERVED

The prison facility was expanded in 2006 to its present size. The facility has a capacity for 2500 inmates and approximately 744 employees. The force main from the MCCX is a dedicated line to the facility; therefore, there are no other connections to the line. There are no immediate plans to expand further; however, it is likely that the facility may need to expand at some point in the future.

III. SERVICE AREA

The service area for the existing six inch force main is limited to the prison at the present time.

IV. DESCRIPTION OF EXISTING COLLECTION AND STORAGE SYSTEM

The sanitary sewer system within the MCCX consists of a mixture of gravity sewer and force mains. There are five on-site pump stations that collect flow from gravity sewers serving their respective areas. These five pump stations pump their flows to a storage or "equalization" tank, which is commonly referred to as the Crom Tank. There are two pumps located within the Crom Tank that pump wastewater from the tank to the six inch force main located in the right-of-way of Flat Fork Road. This is the force main that conveys the wastewater flow to the Wartburg Wastewater Treatment Plant. During normal flow periods, the wastewater level is maintained at a depth of approximately one foot in the Crom Tank. During peak flows the wastewater depth may increase to four or five feet. There is not currently an alternative to the Crom Tank. If the equalization tank needs to be shut down for any reason, there is enough storage capacity to last for approximately two days without emergency pumping.

The Crom Tank has had operational issues from the first day it was put into operation. Storage of wastewater at depths of four to five feet (in accordance with the training received upon final completion of the wastewater system) has caused the generation of hydrogen sulfide which has not only been an odor problem, but has also led to generation of sulfuric acid which has caused premature failure of the chopper and mixer pumps located within the tank, and degradation of the electrical control panels outside of the tank. A Purafil Odor Control Filter was installed on the outlet air vent from the tank to control the odors; however, the filters have a limited life span, and are very expensive to replace. The cost for each change of the filters is approximately $11,000, and the filters need to be changed three to four times a year. There is also a step screen to intercept large solids from the waste stream prior to discharge into the Crom Tank. This screen has also had a series of issues caused by both freezing and degradation due to the sulfuric acid which was generated from the hydrogen sulfide. Part availability has also been an issue for the step screen since the unit is made in Sweden. Storage of wastewater in the tank has also led to an increase in the total suspended solids in the effluent, which has led to numerous "Notices of Violation" of the MCCX's wastewater pretreatment permit.

The existing six-inch force main from the MCCX facility to the wastewater treatment plant is thirty-one years old. It is a PVC line that was installed in 1983 to serve the original prison facility. It conveyed treated wastewater from the wastewater treatment plant at the original prison facility directly to Crooked Fork Creek. When the prison facility was expanded in 2006, the Wartburg Wastewater Treatment Plant was also in the process of undergoing an expansion. Rather than construct a new wastewater treatment plant as part of the MCCX expansion, it was negotiated to have the prison wastewater flows discharge to the newly expanded Wartburg Wastewater Treatment Plant. The existing force main was intercepted just prior to entering the creek, and re-directed to the Wartburg Wastewater Treatment Plant.

There is not any known evidence indicating that there are any issues with the existing six-inch force main other than its limited flow capacity. The line appears to be handling the average daily flows without any problems. The fact that the line is made of PVC is good in that the interior of the pipe is not subject to corrosion which would be an issue with a ductile iron pipe. Also, the flow characteristics of PVC are very good, and do not degrade significantly over time. However, since the line is PVC, there are concerns about the structural integrity of the pipe in several areas. On the west side of Highway 62, the line leaves the road right-of-way of Flat Fork Road, and follows Mud creek to the wastewater treatment plant. Over thirty years the trees in the area have grown up significantly, and the roots from the trees may be stressing the pipe even though it does not appear to have failed. Over the years there has also been significant development in the area, so there is the possibility the line has been compromised structurally or illegally tapped in various locations. The only way to verify the condition of the pipe would be to uncover the pipe at various locations and televise as much of the line as feasible. This would be an expensive undertaking, and would also mean shutting down the equalization tank for eight to ten hours a day while the inspection is underway. This could potentially put the prison facility at risk, should a failure occur while the tank is near full after a day of holding the wastewater flows. The potential rewards of the investigation are tempered by the fact that we know the six inch line lacks adequate capacity to serve the MCCX.

V. EXISTING SYSTEM – HYDRAULIC ANALYSIS

A hydraulic analysis of the existing system, utilizing current Tennessee Department of Environment and Conservation criteria is as follows:

DESIGN FLOW CALCULATION

Maximum inmate population = 2500 persons
Number of employees = 744 persons
Design basis for flow from Chapter 2 – Design Criteria, Appendix 2-A
(refer to sheet 2 - Appendix A)
Inmates = 120 GPD
Employees = 10 GPD
Average Flow, Q = 2500 (120 GPD) + 744 (10 GPD) = 307,440 GPD = 214 GPM

The maximum flow per the contract between the MCCX facility and the city of Wartburg is 350,000 GPD, or 243 GPM. Therefore, the calculated average daily flow is slightly below the negotiated wastewater flow value.

Peak Flow, per Chapter Two, Section 2.2.2 (refer to sheet 1- Appendix A) – Basis of Design is as follows:
Qp = Average Flow (250%) = 214 GPM (2.50) = 535 GPM

EXISTING FORCE MAIN LENGTH

Based upon the As-Built Plans for the six-inch force main, the sanitary sewer plans for the MCCX expansion, and the scaled distance for the connection to the Wartburg Wastewater Treatment Plant, the total length of line is approximately 12,310 LF.
Friction head loss at 535 GPM = 329 FT (refer to calculation sheet 1 in Appendix B)

ELEVATION DIFFERENCE

Elevation of the pumps in the equalization tank = 1252.75

Elevation at the Highway 62 road crossing (high point) = 1287.00

Elevation at the Wartburg Wastewater Treatment Plant = 1250.00 +/-

Elevation head loss = 34.25 FT (refer to calculation sheet 1 in Appendix B)

EVALUATION OF PUMPS

There are two pumps in the Crom Tank – one is one of the two original KSB pump and the second is a Meyers pump, which replaced one of the two original KSB pumps. The Meyers pump is a 4VB400M4-43 Non-Clog pump with a 460 volt, 40 HP motor which operates at 1750 RPM and is fitted with an 11 inch impeller. This data is typical for the KSB pump also. The Meyers pump can operate effectively up to heads of approximately 145 feet maximum. The average flow of 214 GPM will generate a head of 133 FT for a six-inch pipe (refer to calculation sheet 2 – Appendix B), which is in the range of the existing pump. The existing system works fine in an "average flow" condition. However, the peak flow of 535 GPM generates a head loss of 329 feet with the existing six inch force main, which is beyond the capacity of the existing pumps (refer to the pump curves in Appendix C). The Crom Tank helps to maintain that condition by storing any excess wastewater flow until it can be released over a period of time. However, if there is a problem in the Crom Tank, the only other option for addressing emergency flows is to bring in pump trucks to drain the tank. If the six-inch force main were increased in size to an eight-inch pipe, the head loss for the peak flow of 535 GPM would be 108 FT, which is well within the capacity of the existing pumps (refer to calculation sheet 3- Appendix B).

VI. SANITARY SEWER SYSTEM DESIGN OPTIONS

The existing wastewater piping system at the MCCX facility does not have a bypass option or an emergency alternative to dispose of wastewater in the case of an emergency. The only existing option to dispose of emergency related wastewater is to bring in pump trucks to pump out the Crom Tank. Potential options to provide the needed redundancy are as follows:

1. Construct a second equalization tank
2. Install a separate pump station with pumps large enough to overcome the friction head generated by pumping flows at 535 GPM through the existing six-inch force main.
3. Install a new eight-inch force main from the MCCX facility to the Wartburg Wastewater Treatment Plant.

Each option is evaluated as follows:

1. Construct a Second Crom Tank

   The existing Crom Tank has been a significant drain on financial resources and manpower. The initial concept of storing wastewater in the Crom Tank is flawed due to the generation of hydrogen sulfide and sulfuric acid. It was necessary to replace all of the mechanical and electrical components of the Crom Tank in 2011 even though the tank was only five years old. It has been recommended that the tank have a special coating applied to the interior to resist corrosion, and air filters have had to be installed on the air vents to minimize the "rotten egg" smell. The step screen has had to have significant repairs due to freezing in the winter months. Most significantly, the storage of wastewater has led to the development of high total suspended solids in the wastewater, which has, in turn, led to numerous violations of the Industrial Wastewater Discharge Permit. The cost to construct an additional equalization tank would be approximately $ 500,000.

2. Install a Separate Pump Station with Larger Pumps

   The use of a larger pump is not practical due to the high pressures developed to overcome the head loss of 329 feet due to the existing six in force main pipe. 329 FT of head is converted to pressure as follows:

   Pressure, P = 0.433 (Head) or
   P = 0.433 (329 FT) = 142.5 PSI

   The pressure specification for the existing six-inch PVC force main is not known; however, typical six-inch pressure pipe is rated for pressures of 100, 125 or 160 PSI. Therefore, installing pumps that would operate at pressures over 100 PSI would most likely exceed the pressure rating of the existing pipe and lead to failure of the pipe.

3. Install a New Eight-Inch Force Main

   Pumping the peak flow of 535 GPM from the MCCX facility would generate a friction head of 108 FT through an eight-inch force main (refer to calculation sheet 3 – Appendix B). This head would generate the following pressure:

   P = 0.433 (108 FT) = 46.8 PSI

   This pressure is well below the pressure rating of typical DR-11, Class 160 HDPE pressure sewer pipe, which has a working pressure of 160 PSI. More importantly, the existing pumps in the Crom Tank can pump the peak flow of 535 GPM at heads up to 115 FT, and this flow rate and head combination intersect the pump curve very close to the pumps peak efficiency rating (intersects as 60% versus the peak at 63%). The cost to install a new eight-inch force main from the MCCX facility to the Wartburg Wastewater Treatment Plant, along with a new pump station is as follows:

12,310 LF – 8 IN PVC CLASS 165 PIPE @ $ 30.00/FT	= $ 370,000
PUMP STATION, COMPLETE	= $ 200,000
TOTAL COST	= $ 570,000

SUMMARY:

Option No. 2 is not a feasible option; therefore, the options are either:

1. a new equalization tank or
2. a new eight-inch force main.

The initial costs are comparable; however, the long-term maintenance costs of a second equalization tank, along with the permanent restriction of the six-inch force main make Option No. 2, a new eight-inch force main, a much more desirable and practical option.

The Wartburg Wastewater Treatment Plant has a design capacity of 0.75 MGD, based upon 0.375 MGD from the City and 0.375 from the MCCX facility. The plant also has a peak capacity of 1.6 MGD. Therefore, should the peak flow from the MCCX facility of 535 GPM or 0.77 MGD ever be realized, the plant has the peak capacity to handle the peak flow from the MCCX facility.

VII. CONCLUSION

It is common practice to design utility systems with emergency backup operation alternatives in case of failure of the primary system. Lack of a backup system has prevented the MCCX facility staff from doing routine maintenance of the wastewater system (the Crom Tank), which has led to a failure of the system. This failure not only had significant financial costs associated with emergency wastewater pumping of the Crom Tank, but it also resulted in the partial shutdown of wastewater service throughout the MCCX facility. Due to the nature of the use of the MCCX facility and the security issues associated with this use, it is imperative for the facility to have redundancy in their wastewater disposal system, and to minimize operational costs and manpower requirements to maintain the system. The existing six-inch force main from the MCCX facility to the Wartburg Wastewater Treatment Plant has been a restrictive element for the facility from the beginning, and, in hindsight, should have been replaced when the facility was expanded.

It is proposed to replace the existing six-inch force main with a new eight-inch HDPE force main. This will allow the MCCX facility to provide redundancy in their wastewater system by installing a new pump station which will collect all on-site wastewater flows and pump them directly to the Wartburg Wastewater Treatment Plant through the new eight-inch force main. The existing Crom Tank will be used as a back-up system for emergency conditions, thereby providing the desired redundancy in the wastewater system. This will reduce the wear on the mechanical elements of the Crom Tank, reduce the man-hours required for its maintenance, and most significantly, it will eliminate the issue of elevated total suspended solids in the effluent from the Crom Tank, and reduce the potential for future violations of the Industrial Wastewater Pretreatment Permit.

APPENDIX A
TENNESSEE DEPARTMENT OF ENVIRONMENT AND CONSERVATION
DESIGN CRITERIA FOR SEWAGE WORKS

1. Page 4 from Chapter 2
2. Appendix 2-A

2.2 Design Considerations

2.2.1 Design Period

2.2.1.1 Collection sewers (Laterals and Submains)

The Division requires collection sewers for the ultimate development of the tributary areas.

2.2.1.2 Main, Trunk, and Interceptor Sewers

The Division requires certain design factors for trunk sewers:

a. Possible solids deposition, odor, and pipe corrosion that might occur at initial flows
b. Population and economic growth projections and the accuracy of the projections
c. Comparative costs of staged construction alternatives
d. Effect of sewer sizing on land use and development

2.2.2 Basis of Design

The Division's design requirements for new sewer systems are on the basis of per capita flows or alternative methods.

2.2.2.1 Per Capita Flow

The Division requires the use of Appendix 2-A. Substitutions or additions to the information presented in this table are acceptable if better or more accurate data is available.

The Division requires the following:

a. Lateral and Submains: Minimum peak design flow should be not less than 400 percent of the average design flow.

"Lateral" - a sewer that has no other common sewers discharging into it.

"Submain" is defined as a sewer that receives flow from one or more lateral sewers.

b. Main, Trunk, and Interceptor sewers: Minimum peak design flow should be not less 250 percent of the average design flow.

"Main" or "trunk" is defined as a sewer that receives flow from one or more submains.

"Interceptor" - a sewer that receives flow from a number of main or trunk sewers, force mains, etc.

2.2.2.2 Alternative Methods

The Division allows alternative methods other than on the basis of per capita flow rates. Alternative methods may include the use of peaking factors of the contributing area, allowances for future commercial and industrial areas, separation of infiltration and inflow from the normal

APPENDIX 2-A

Design Basis for Wastewater Flow and Loadings

Table 2-A.1. Typical Wastewater Flow Rates from Commercial Sources
(Source: Crites and Tchobanoglous, 1998)

FACILITY	UNIT	Flow, gallons/unit/day	
		Range	Typical
Airport	Passenger	2 - 4	3
Apartment House	Person	40 - 80	50
Automobile Service Station	Vehicle served	8 - 15	12
	Employee	9 - 15	13
Bar	Customer	1 - 5	3
	Employee	10 - 16	13
Boarding House	Person	25 - 60	40
Department Store	Toilet Room	400 - 600	500
	Employee	8 - 15	10
Hotel	Guest	40 - 60	50
	Employee	8 - 13	10
Industrial Building (Sanitary waste only)	Employee	7 - 16	13
Laundry (self-service)	Machine	450 - 650	550
	Wash	45 - 55	50
Office	Employee	7 - 16	13
Public Lavatory	User	3 - 6	5
Restaurant (with toilet)	Meal	2 - 4	3
Conventional	Customer	8 - 10	9
Short order	Customer	3 - 8	6
Bar/cocktail lounge	Customer	2 - 4	3
Shopping Center	Employee	7 - 13	10
	Parking Space	1 - 3	2
Theater	Seat	2 - 4	3

Table 2-A.2. Typical Wastewater Flow Rates from Institutional Sources
(Source: Crites and Tchobanoglous, 1998)

FACILITY	UNIT	Flow, gallons/unit/day	
		Range	Typical
Assembly Hall	Seat	2 - 4	3
Hospital, Medical	Bed	125 -240	165
	Employee	5 - 15	10
Hospital, Mental	Bed	75 - 140	100
	Employee	5 - 15	10
Prison	Inmate	80 - 150	120
	Employee	5 - 15	10
Rest Home	Resident	50 - 120	90
	Employee	5 - 15	10
School, day-only			
With cafeteria, gym, showers	Student	15 - 30	25
With cafeteria only	Student	10 - 20	15
Without cafeteria, gym, or showers	Student	5 - 17	11
School, boarding	Student	50 - 100	75

APPENDIX B
DESIGN SPREADSHEETS

1. Head loss in the existing six-inch pipe at the peak flow of 535 GPM
2. Head loss in the existing six-inch pipe at the average flow of 214 GPM
3. Head loss in an eight-inch pipe at the peak flow of 535 GPM

SANITARY SEWER FLOW/PRESSURE CALCULATION SPREADSHEET

PROPOSED FORCE MAIN DESIGN

PROJECT: MORGAN COUNTY DEPARTMENT OF CORRECTION
PROJ NO: 500925.015
FILE NO: 500925.015FORCEMAIN.XLS
DATE: 7/10/2014

EXISTING 6" PVC FORCE MAIN AT THE PEAK FLOW OF 535 GPM

A) ELEVATION HEAD LOSS CALCULATION

HIGH POINT IN THE LINE IS AT THE HIGHWAY 62 CROSSING

EXISTING ELEVATION AT SUMP OF CROM TANK				HIGHWAY 62 CROSSING	ELEV DIFF	HYD GRAD EXISTING CONNECT	STATIC PRESSURE POS#1
STATIC PRES	RESIDUAL PRES	FLOW	ELEV	ELEV			
$Pstat_1$	$Pres_1$	Q	$Elev_1$	$Elev_2$			$Pstat_2$
(PSI)	(PSI)	(GPM)	(FT)	(FT)	(FT)	(FT)	(PSI)
			1252.75	1287	34.25	1252.75	-14.83

B) USING EXISTING 6" PLASTIC FORCE MAIN:

Q= 535 GPM

LINE HEAD LOSSES (HL):

PIPE/ FITTING	LENGTH OR NUMBER	EQUIV LENGTH-PIPE DIA	PIPE DIA (IN)	RESULTANT PIPE LENGTH (FT)	PIPE MATERIAL	C FACTOR	HL PER 1000 FT (FT)	HL (ADJ) (FT)	
PIPE	12310		6	12310	DI	130	23.4	287.80	
			8	0	DI	130	5.8	0.00	
	0		10	0	DI	130	1.9	0.00	
VALVE	10	17	6	85.0	DI	130	23.4	1.99	
	0	17	8	0.0	DI	130	5.8	0.00	
	0	17	10	0.0	DI	130	1.9	0.00	
90D BEND	6	27	6	81.0	DI	130	23.4	1.89	
	0	27	8	0.0	DI	130	5.8	0.00	
	0	27	10	0.0	DI	130	1.9	0.00	
45D BEND	16	15	6	120.0	DI	130	23.4	2.81	
	0	15	8	0.0	DI	130	5.8	0.00	
	0	15	12	0.0	DI	130	0.8	0.00	
TEE(RUN)	0	20	6	0.0	DI	130	23.4	0.00	
	0	20	8	0.0	DI	130	5.8	0.00	
	0	20	10	0.0	DI	130	1.9	0.00	
TEE(BRCH)	0	60	6	0.0	DI	130	23.4	0.00	
	0	60	8	0.0	DI	130	5.8	0.00	
	0	60	10	0.0	DI	130	1.9	0.00	
						PIPE FRICTION HL =		294.48	FT
						ELEVATION HL =		34.25	FT
						TOTAL HL =		328.73	FT

SANITARY SEWER FLOW/PRESSURE CALCULATION SPREADSHEET

EXISTING CONDITIONS

PROJECT: MORGAN COUNTY DEPARTMENT OF CORRECTION
PROJ NO: 500925.015
FILE NO: 500925.015EXISTFM.XLS
DATE: 7/10/2014

EXISTING 6" PVC FORCE MAIN AT THE EXISTING FLOW OF 214 GPM

A) ELEVATION HEAD LOSS FROM PRISON TO THE WASTEWATER TREATMENT PLANT
HIGH POINT IN THE LINE IS AT THE HIGHWAY 62 ROAD CROSSING

EXISTING ELEVATION AT THE SUMP OF THE CROM TANK				HIGHWAY 62 CROSSING	ELEV DIFF	HYD GRAD EXIST CONNECT	STATIC PRESSURE POS#2
STATIC PRES	RESIDUAL PRES	FLOW	ELEV	ELEV			
$Pstat_1$	$Pres_1$	Q	$Elev_1$	$Elev_2$			$Pstat_2$
(PSI)	(PSI)	(GPM)	(FT)	(FT)	(FT)	(FT)	(PSI)
			1252.75	1287	34.25	1252.75	-14.83

B) RESIDUAL PRESSURE AT POINT OF SERVICE #2: Q= 214 GPM

LINE HEAD LOSSES (HL):

PIPE/ FITTING	LENGTH OR NUMBER	EQUIV LENGTH-PIPE DIA	PIPE DIA (IN)	RESULTANT PIPE LENGTH (FT)	PIPE MATERIAL	C FACTOR	HL PER 1000FT (FT)	HL (ADJ) (FT)	
PIPE	12310		6	12310	PVC	130	4.3	52.74	
	0		8	0	PVC	130	1.1	0.00	
	0		10	0	PVC	130	0.4	0.00	
VALVE	10	17	6	85.0	PVC	130	4.3	0.36	
	0	17	8	0.0	PVC	130	1.1	0.00	
	0	17	10	0.0	PVC	130	0.4	0.00	
90D BEND	6	27	6	81.0	PVC	130	4.3	0.35	
	0	27	8	0.0	PVC	130	1.1	0.00	
	0	27	10	0.0	PVC	130	0.4	0.00	
45D BEND	16	15	6	120.0	PVC	130	4.3	0.51	
	0	15	8	0.0	PVC	130	1.1	0.00	
	0	15	12	0.0	PVC	130	0.1	0.00	
TEE(RUN)	0	20	6	0.0	PVC	130	4.3	0.00	
	0	20	8	0.0	PVC	130	1.1	0.00	
	0	20	10	0.0	PVC	130	0.4	0.00	
TEE(BRCH)	0	60	6	0.0	PVC	130	4.3	0.00	
	0	60	8	0.0	PVC	130	1.1	0.00	
	0	60	10	0.0	PVC	130	0.4	0.00	
						PIPE FRICTION HL =		53.97	FT
						ELEVATION HL =		34.25	FT
						TOTAL HL =		88.22	FT

NEW 8" PVC FORCE MAIN AT THE PEAK FLOW OF 535 GPM

A) ELEVATION HEAD LOSS CALCULATION

HIGH POINT IN THE LINE IS AT THE HIGHWAY 62 CROSSING

EXISTING ELEVATION AT SUMP OF CROM TANK				HIGHWAY 62 CROSSING	ELEV DIFF	HYD GRAD EXISTING CONNECT	STATIC PRESSURE POS#1
STATIC	RESIDUAL	FLOW	ELEV	ELEV			
PRES	PRES						
$Pstat_1$	$Pres_1$	Q	$Elev_1$	$Elev_2$			$Pstat_2$
(PSI)	(PSI)	(GPM)	(FT)	(FT)	(FT)	(FT)	(PSI)
			1252.75	1287	34.25	1252.75	-14.83

B) USING A NEW 8" HDPE FORCE MAIN:

LINE HEAD LOSSES (HL):

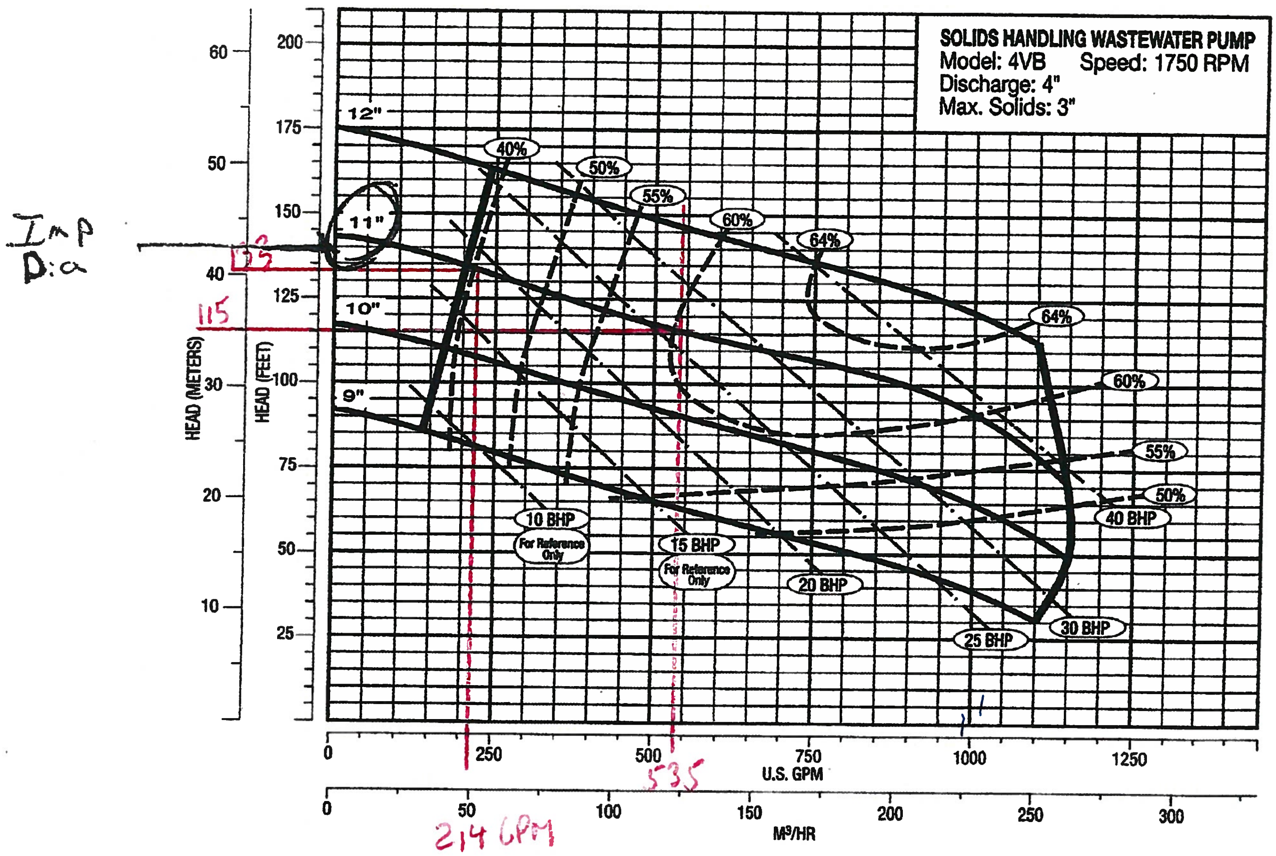
Q= 535 GPM

PIPE/ FITTING	LENGTH OR NUMBER	EQUIV LENGTH- PIPE DIA	PIPE DIA (IN)	RESULTANT PIPE LENGTH (FT)	PIPE MATERIAL	C FACTOR	HL PER 1000 FT (FT)	HL (ADJ) (FT)	
PIPE	0		6	0	DI	130	23.4	0.00	
	12310		8	12310	DI	130	5.8	70.89	
	0		10	0	DI	130	1.9	0.00	
VALVE	0	17	6	0.0	DI	130	23.4	0.00	
	10	17	8	113.3	DI	130	5.8	0.65	
	0	17	10	0.0	DI	130	1.9	0.00	
90D BEND	0	27	6	0.0	DI	130	23.4	0.00	
	6	27	8	108.0	DI	130	5.8	0.62	
	0	27	10	0.0	DI	130	1.9	0.00	
45D BEND	0	15	6	0.0	DI	130	23.4	0.00	
	16	15	8	160.0	DI	130	5.8	0.92	
	0	15	12	0.0	DI	130	0.8	0.00	
TEE(RUN)	0	20	6	0.0	DI	130	23.4	0.00	
	0	20	8	0.0	DI	130	5.8	0.00	
	0	20	10	0.0	DI	130	1.9	0.00	
TEE(BRCH)	0	60	6	0.0	DI	130	23.4	0.00	
	0	60	8	0.0	DI	130	5.8	0.00	
	0	60	10	0.0	DI	130	1.9	0.00	
						PIPE FRICTION HL =		73.09	FT
						ELEVATION HL =		34.25	FT
						TOTAL HL =		107.34	FT

APPENDIX C
PUMP CURVE

1. Meyers Pump Curve

1750 RPM PERFORMANCE CURVE



Available Models		Motor Electrical Data												
4VB200M4-03	4VBX200M4-03	20	200	3	60	334	69	82.8	21.2	26.1	115.5	23.9	G	1.2
4VB200M4-23	4VBX200M4-23	20	230	3	60	290	60	72	21.2	26.1	115.5	23.9	G	1.2
4VB200M4-43	4VBX200M4-43	20	460	3	60	145	30	36	21.2	26.1	115.5	23.9	G	1.2
4VB200M4-53	4VBX200M4-53	20	575	3	60	116	24	28.8	21.2	26.1	115.5	23.9	G	1.2
4VB250M4-03	4VBX250M4-03	25	200	3	60	575	78.3	92.2	26.9	33.3	180.1	30.3	G	1.2
4VB250M4-23	4VBX250M4-23	25	230	3	60	452	76	92	26.9	33.3	180.1	30.3	G	1.2
4VB250M4-43	4VBX250M4-43	25	460	3	60	226	38	44	26.9	33.3	180.1	30.3	G	1.2
4VB250M4-53	4VBX250M4-53	25	575	3	60	181	30.4	36.8	26.9	33.3	180.1	30.3	G	1.2
4VB300M4-03	4VBX300M4-03	30	200	3	60	575	103.9	124	33.3	41.3	180.1	37.4	G	1.2
4VB300M4-23	4VBX300M4-23	30	230	3	60	452	94	114	33.3	41.3	180.1	37.4	G	1.2
4VB300M4-43	4VBX300M4-43	30	460	3	60	226	47	57	33.3	41.3	180.1	37.4	G	1.2
4VB300M4-53	4VBX300M4-53	30	575	3	60	181	37.6	45.6	33.3	41.3	180.1	37.4	G	1.2
4VB400M4-23	4VBX400M4-23	40	230	3	60	580	122	148	43.2	53.0	231.1	48.6	G	1.2
4VB400M4-43	4VBX400M4-43	40	460	3	60	290	61	74	43.2	53.0	231.1	48.6	G	1.2
4VB400M4-53	4VBX400M4-53	40	575	3	60	232	48.8	59.2	43.2	53.0	231.1	48.6	G	1.2
4VB500M4-43	4VBX500M4-43	50	460	3	60	290	67	79	46.9	54.6	231.1	53.4	E	1.2
4VB500M4-53	4VBX500M4-53	50	575	3	60	232	54	63	46.9	54.6	231.1	53.4	E	1.2

Motor Efficiencies and Power Factor									
20	3	88	87.5	81	72.5	91	89	79	59
25	3	87	86	81	73	91	89	80	70
30	3	87	86	83	79	91	89	82	73
40	3	86	86	88	87.5	90	89	86	80
50	3	87	86	86.5	88	87	83	89.5	84